

02/18/00

jc644 U.S. PTO

02-22-00

A

PATENT APPLICATION TRANSMITTAL LETTER
(Small Entity)Docket No.
P 00 572.006TO THE ASSISTANT COMMISSIONER FOR PATENTS

Transmitted herewith for filing under 35 U.S.C. 111 and 37 C.F.R. 1.53 is the patent application of:

Seiji Yamashita

For: **METHOD AND APPARATUS FOR REDUCING CONTAMINATION IN A PLASTIC CONTAINER**

Enclosed are:


- ☒ Certificate of Mailing with Express Mail Mailing Label No. **EL468486428US**
- ☒ Two sheets of drawings.
- ☐ A certified copy of a _____ application.
- ☒ Declaration ☒ Signed. ☐ Unsigned.
- ☒ Power of Attorney
- ☐ Information Disclosure Statement
- ☐ Preliminary Amendment
- ☒ One Verified Statement(s) to Establish Small Entity Status Under 37 C.F.R. 1.9 and 1.27.
- ☐ Other:

jc542 U.S. PTO
09/507212
02/18/00**CLAIMS AS FILED**

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	13	- 20 =	0	x \$9.00	\$0.00
Indep. Claims	3	- 3 =	0	x \$39.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$345.00
TOTAL FILING FEE					\$345.00

- ☒ A check in the amount of **\$345.00** to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. **02-2451** as described below. A duplicate copy of this sheet is enclosed.
- ☐ Charge the amount of _____ as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Dated: February 18, 2000


Signature
Garth Janke, Reg. No. 40,662
BIRDWELL & JANKE, LLP
900 SW Fifth Avenue, Suite 1925
Portland, Oregon 97204
(503) 228-1841

cc:

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(f) AND 1.27 (b)) - INDEPENDENT INVENTOR**

Docket No.
P 00 572.006

Serial No.

Filing Date

Patent No.

Issue Date

Concurrently Herewith

Applicant/ **Seiji Yamashita**

Patentee:

Invention: **METHOD AND APPARATUS FOR REDUCING CONTAMINATION IN A PLASTIC CONTAINER**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled above and described in:

- ☒ the specification to be filed herewith.
☐ the application identified above.
☐ the patent identified above.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ No such person, concern or organization exists.
☐ Each such person, concern or organization is listed below.

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities (37 CFR 1.27)

FULL NAME

ADDRESS

☐

Individual

☐

Small Business Concern

☐

Nonprofit Organization

FULL NAME

ADDRESS

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Individual

☐

Small Business Concern

☐

Nonprofit Organization

FULL NAME

ADDRESS

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Individual

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Small Business Concern

☐

Nonprofit Organization

FULL NAME

ADDRESS

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Individual

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Small Business Concern

☐

Nonprofit Organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF INVENTOR Seiji Yamashita

SIGNATURE OF INVENTOR 

DATE: February 16, 2000

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

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09507212-024000

METHOD AND APPARATUS FOR REDUCING CONTAMINATION IN A PLASTIC CONTAINER

Background of the Invention

The present invention relates to a method and apparatus for reducing contamination in a plastic container, particular such a container that is employed for transporting semiconductor wafers in a semiconductor device manufacturing facility.

The ever present need to reduce particulate contamination in semiconductor device fabrication is well known. Within the clean room, semiconductor wafers are often transported between fabrication operations in closed, plastic containers. As the clean room is not completely devoid of particles, the containers assist in preventing some particles from reaching the wafers. However, the containers also introduce some contamination. For one thing, the containers may themselves have particles in them and, to prevent this, the containers need to be cleaned frequently. Typically, a detergent must be used to clean the internal surfaces of the container, the detergent being required to dislodge particles attracted to the container walls so that the particles may be flushed out. Organic molecules are also deposited on the interior surfaces of the containers used in 300 mm wafer processing. These containers are open to the machines processing the wafers with, among other things, photo-resist, and acquire deposits of organic compounds that must be cleaned with a solvent. Another form of contamination arises from outgassing of the plastic material. Organic molecules are constantly being released from the plastic and accumulate inside the closed container. These molecules deposit themselves on the wafers, further contaminating them.

To accomplish both types of cleaning has required separate washing facilities, for introducing both the detergent and the solvent. The use of the plastic container, though providing advantages, also exacts penalties in higher cost and increased manufacturing time. Accordingly, there is a need for a method and apparatus for reducing contamination in a plastic container that reduces or eliminates these penalties.

Summary of the Invention

The method and apparatus for reducing contamination in a plastic container of the present invention solves the aforementioned problems and meets the aforementioned needs by providing a coating for selected surfaces of the plastic container, the coating preferably including titanium dioxide. Such a coating serves two functions. First, it causes the surface of the plastic container to wet more easily and, therefore, a detergent is no longer necessary for removing particles therefrom. Second, the coating reacts with the organic molecules emitted from the plastic so as to render them harmless to the contents stored inside the container. This eliminates the need for cleaning the contents with a solvent.

Therefore, it is a principal object of the present invention to provide a novel and improved method and apparatus for reducing contamination in a plastic container.

It is another object of the present invention to provide a method and apparatus for reducing contamination in a plastic container that reduces cost.

It is still another object of the present invention to provide a method and apparatus for reducing contamination in a plastic container that decreases manufacturing time.

The foregoing and other objects, features and advantages of the present invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the following drawings.

Brief Description of the Drawings

Figure 1 is a pictorial view of a plastic container for use with the present invention.

Figure 2 is a partial, section view of the container of Figure 1, taken along a line 2-2 thereof, showing a coating according to the present invention.

Detailed Description of a Preferred Embodiment

Referring to the Figure, a container 12 is preferably adapted for holding a plurality of semiconductor wafers 16 for storage or transport of the wafers. The invention is particularly adapted for use in semiconductor fabrication and to reduce the contamination of the wafers 16; however, the invention may be employed as well for the reduction of contamination of other articles used for other purposes.

The container has a body 18 and a closeable lid 20 adapted for sealing the wafers inside the container from the external atmosphere. The container is formed of a plastic material, typically polypropylene or polycarbonate. One characteristic of the plastic material that is pertinent to the present invention is that it releases organic molecules. Another characteristic of the plastic material that is pertinent to the present invention is that it is hydrophobic, so that a detergent is better able to remove any dust particles that have been attracted or attached to the

surface of the plastic material than is water alone. For purposes herein, a “plastic material” is any material having one or both of these characteristics.

Referring to Figure 2, according to the invention, a coating 22 is provided on selected surfaces of the plastic container 12. The relative thickness of the coating with respect to the plastic material forming the container 12 is shown highly exaggerated for illustration purposes only. The coating is adapted to reduce contamination inside the container 12 as discussed below. Referring back to Figure 1, preferably, at least the entire interior 24 of the container 12, including the interior 24a of the body 18 and the bottom 24b of the closeable lid 20, are covered with the coating. Reducing the surface area that is provided with the coating will reduce the reduction of contamination in proportion.

Preferably, the coating 22 includes titanium dioxide and serves two functions. First, it is has been found to provide a surface that wets more easily than the plastic material (i.e., it is relatively “hydrophilic”). Therefore, water alone may be effective to loosen particulate contamination that is attracted or attached to the coating, and the container may be cleaned simply by rinsing it or by dipping it in a bath, rather than washing it in a detergent.

It is believed that titanium dioxide provides a hydrophilic coating 22 by reacting, from the energy provided by ambient ultraviolet light, with the hydroxyl ion OH^- that is naturally present in atmospheric water vapor. This is believed to form a modified coating structure that includes hydroxyl groups for attracting water molecules. However, the coating may alternatively or in addition include one or more other chemicals, compositions or materials that are relatively hydrophilic without departing from the principles of the invention.

It is also believed that the modified coating structure is a photocatalyst for a further reaction with organic molecules, such as butylated hydroxytoluene (BHT) and tetrahydrofuran (THF), released from the plastic material. Particularly, it is believed that, from the energy provided by ambient ultraviolet light, the organic molecules give up electrons to the hydroxyl groups, and decompose into CO_2 and H_2 molecules that are harmless to the semiconductor wafers stored inside the container.

Such organic molecules are also deposited on the interior surfaces of the container, as well as other organic molecules produced by applying photo-resist to the wafers removable from the container. The latter source of organic molecules has become important as a result of moving to 300 mm wafer processing, wherein the lid of the container is opened and remains open to a wafer processing machine during the time of processing, such as during the time photo-resist is being applied. The same reaction described above is believed to alleviate the need for cleaning the container with a solvent.

So far as is known, titanium dioxide is unique in providing for both of these functions. It may be obtained in a gel form from Photocatalytic Materials, Inc., 400 Iwasaki, Kamaki city, Aichi Pref., Japan. The concentration is about 3%. To produce the coating 22, the container 12 is preferably dip coated in the gel. It has been found that the duration and temperature of the dipping are not critical. Coating thickness may vary depending on the speed with which the container is removed from the "bath," where a higher speed of removal results in a coating of lesser thickness. See Taoda, et al., U.S. Patent No. 5,562,820, incorporated by reference herein in its entirety, for a general indication of methods for applying a gel to produce a coating.

It is to be recognized that, while a particular method and apparatus for reducing contamination in a plastic container has been shown and described as preferred, other configurations and methods could be utilized, in addition to those already mentioned, without departing from the principles of the invention.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention of the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

Claims:

1. A method for reducing contamination inside a container including a plastic material, comprising coating selected portions of the plastic material of the container with a coating that includes titanium dioxide.
2. The method of claim 1, wherein the container is especially adapted for holding semiconductor wafers, and wherein the selected portions are interior surfaces of the container.
3. The method of claim 1, further comprising selecting the plastic material so that the plastic material includes polypropylene.
4. The method of claim 1, further comprising selecting the plastic material so that the plastic material includes polycarbonate.
5. A method for reducing contamination in a container including a plastic material, comprising coating selected portions of the container with a coating that is adapted to be relatively hydrophilic, wherein said coating is further adapted to decompose organic molecules into gases.
6. The method of claim 5, further comprising selecting the plastic material so that the plastic material includes polypropylene.

7. The method of claim 5, further comprising selecting the plastic material so that the plastic material includes polycarbonate.
8. The method of claim 5, wherein said coating is adapted to be more hydrophilic than the plastic material as a result of being energized by ultraviolet light.
9. The method of claim 8, wherein said coating is adapted to photocatalyze a reaction with organic molecules with the energy provided by ultraviolet light.
10. An apparatus for reducing contamination of an article, comprising a container adapted for holding the article, said container including a plastic material, the apparatus further comprising a coating on selected portions of said plastic material of said container, said coating including titanium dioxide.
11. The apparatus of claim 10, wherein said container includes a closeable lid for substantially sealing the interior of the container from the external atmosphere.
12. The apparatus of claim 11, wherein said container includes polypropylene.
13. The apparatus of claim 11, wherein said container includes polycarbonate.

ABSTRACT

A method and apparatus for reducing contamination in a plastic container. A coating is provided for the container serving two functions. First, it causes the surface of the container to wet more easily. Second, it reacts with organic molecules emitted from the container so as to render them harmless to the contents stored inside the container.

PATAPP2 006

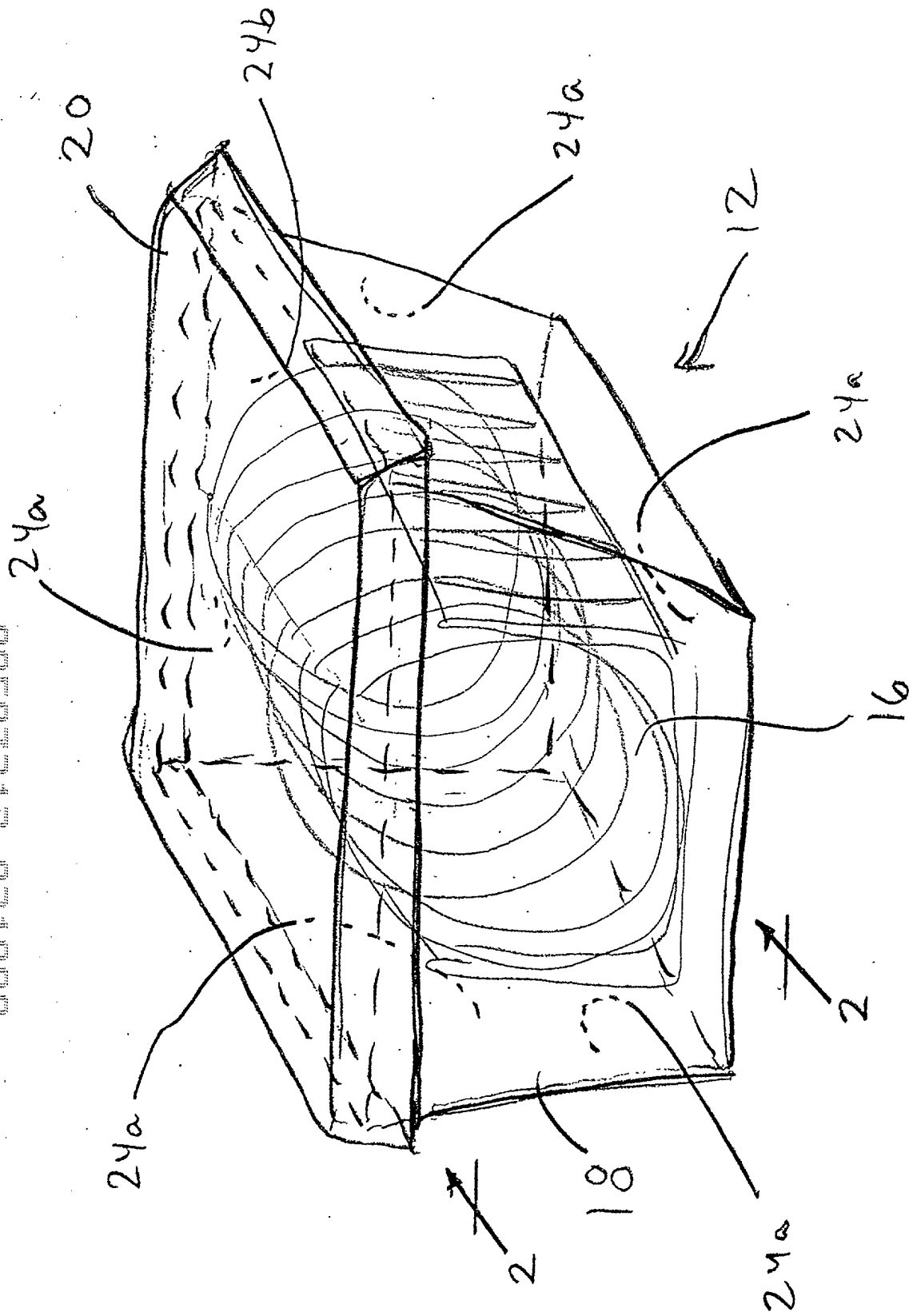


FIG. 1

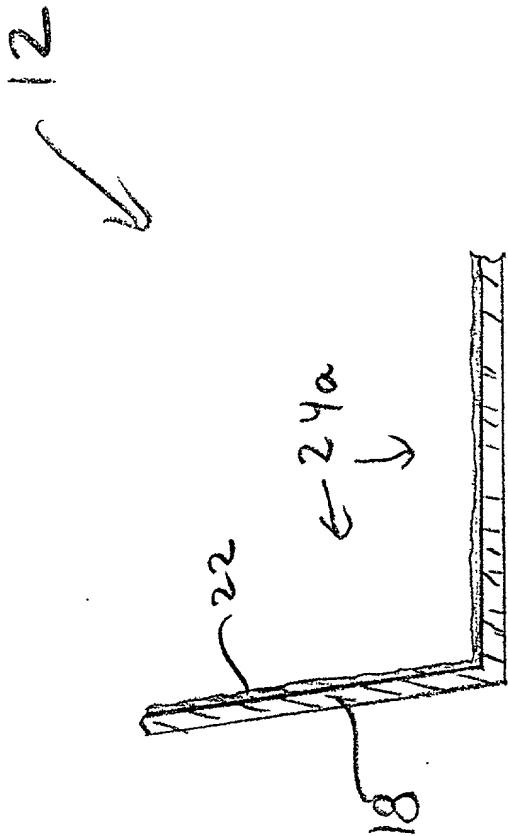


FIG 2

Docket No.

P 00 572.006

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD AND APPARATUS FOR REDUCING CONTAMINATION IN A PLASTIC CONTAINER

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on _____ as United States Application No. or PCT International Application Number _____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

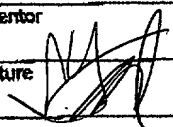
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

Garth Janke, Reg. No. 40,662
 William A. Birdwell, Reg. No. 27,181
BIRDWELL & JANKE, LLP
 900 SW Fifth Avenue, Suite 1925
 Portland, Oregon 97204
 (503) 228-1841

Send Correspondence to: Garth Janke
BIRDWELL & JANKE, LLP
 900 SW Fifth Avenue, Suite 1925
 Portland, Oregon 97204

Direct Telephone Calls to: *(name and telephone number)*
 Garth Janke (503) 228-1841

Full name of sole or first inventor Seiji Yamashita		Date February 16, 2000
Sole or first inventor's signature		
Residence Vancouver, Washington		
Citizenship Japan		
Post Office Address 12700 SE Forest Street		
Vancouver, WA 98683		

Full name of second inventor, if any	
Second inventor's signature	Date
Residence	
Citizenship	
Post Office Address	